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| EXAMINER |
|---|
| DAY, HERNG DER |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2123 | |

DATE MAILED: 09/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/301,961 | PEIRCE ET AL. | |
| | Examiner | Art Unit | |
| | Herng-der Day | 2123 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *25 June 2003 and 22 July 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-4,6-10 and 12-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-10 and 12-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 April 1999* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

**1.** This communication is in response to Applicants' Response (paper # 10) to Office Action dated July 11, 2003 (paper # 9), mailed July 22, 2003 and Applicants' Response (paper # 8) to Office Action dated February 26, 2003 (paper # 6), mailed June 25, 2003.

**1-1.** Claims 1, 3, 8, 13, 17, and 19 have been amended; claims 5, 11, and 20 have been cancelled; claims 1-4, 6-10, and 12-19 are pending.

**1-2.** Claims 1-4, 6-10, and 12-19 have been examined and claims 1-4, 6-10, and 12-19 have been rejected.

### *Information Disclosure Statement*

**2.** Applicants are silent in response to Examiner's information request (section **3**, paper # 6). The Examiner requests again the detailed information about the FracCADE package referred to in the specification and drawings, including the application of a mesh of elements and the element updating algorithm, because it appears to be reasonably necessary to the examination of this application and cannot be located.

As described in page 2 of the reference document CC submitted with the information disclosure statement (paper # 2), "FracCADE's technology can help you with simple reservoirs and more complex isolated multiple-layer reservoirs" has been disclosed in section "The Power to Design". Also disclosed in page 1 is that FracCADE will "Use the pseudo three-dimensional (P3D) hydraulic fracturing simulator". It appears that the FracCADE discloses the simulation of a multiple-layer reservoir. However, in page 3, lines 10-20, of the specification, Applicants

argue that the P3D method cannot accurately represent fracture geometry in more complex treatments that involve multiple geological layers underground. It is also noted that the FracCADE package is used to input data and output results as shown in FIG. 18 to FIG. 20.

### *Specification*

**3.** The objection to specification in section **5-1** of paper # 6 has been withdrawn.

### *Claim Rejections - 35 USC § 112*

**4.** The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

**5.** Claims 1-4, 6-10, and 12-19 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

**5-1.** First, a detailed description has not been provided for some of the variables shown in the equations. For example, it is unclear for one skilled in the art what the exact meaning is for $\sigma_{ij,j}$, what the ranges are for $i$ and $j$ as shown in equation (1), and what is the difference between $\sigma_{ij,j}$ and $\sigma_{ij}$ as shown in equation (2).

Applicants argue, as described in page 13 of paper # 8, "Details about the index notation can be found for instance in "Boundary Element Methods In Solid Mechanic", by S.L. Crouch and A.M. Starfield, first published in 1983, with copies of pages 8-9 and 17-18 attached to this

response". However, the above-mentioned copies cannot be located in paper # 8. Unless the details about the index notation have been incorporated into the specification, it is unclear for one skilled in the art to make and/or use the invention without undue experiment.

**5-2.** Next, as described in the revised page 25, "the $\alpha_j^l$ are the roots of the characteristic equation for the system of ordinary differential equations", however, it is unclear for one skilled in the art why $\alpha_j$ is layer independent while all other variables are layer dependent in a multiplayer environment as shown in equation (9).

**5-3.** Then, as described in lines 6-8 of page 25, "the $A_j^l(k)$ are free parameters of the solution that are determined by the forcing terms $b_j$ in (1)", however, $b_j$ does not exist in (1). Therefore, it is unclear for one skilled in the art how to determine the $A_j^l(k)$ without undue experiment.

Applicants argue, as described in page 14 of paper # 8, "the term $b_i$ in equation (1) can be indifferently re-written $b_j$". However, when refers to equation (1), $b_j$, as a fact, does not exist in equation (1).

**5-4.** Independent claim 1, for example, recites the limitation, "the first data set comprising at least one of the following: time history of fluid volumes, time history of proppant volumes, fluid properties, proppant properties, and geological properties". When the first data set comprising only the data of, for example, time history of fluid volumes, and no data about any properties, it satisfied the "at least one" requirement. However, without undue experiment, it is unclear for one skilled in the art how to determine dimensions of a hydraulic fracture by values computed by manipulating only the data of "time history of fluid volumes" using equations comprising hydraulic fracturing relationships.

**5-5.** Claim 8 recites a method for monitoring or evaluating the fracture of a well in real time. However, as described in lines 12-13 of page 32, "such a process would likely exclude the possibility of real time processing". Therefore, without undue experiment, it is unclear for one skilled in the art how to monitor or evaluate the fracture of a well in real time with a process would likely exclude the possibility of real time processing.

**6.** The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**7.** Claims 1-4 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

**7-1.** Claim 1 recites the limitation "the equilibrium equations" in step (c) of the claim. There is insufficient antecedent basis for this limitation in the claim.

**7-2.** Claims 2-4 are rejected as being dependent on the rejected claim 1.

### *Claim Rejections - 35 USC § 103*

**8.** The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

**9.** Claims 1-2 and 13-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over "GOHFER Grid Oriented Hydraulic Fracture Extension Replicator", Stim-Lab, Inc. and Marathon Oil Company, 1996 (reference document CA, paper # 2, referred to as GOHFER), in

view of Linkov et al., "An Effective Method for Multi-Layered Media with Cracks and Cavities", International Journal of Damage Mechanics, Vol. 3, October 1994, pages 338-356 (reference document CO, paper # 2).

**9-1.** Regarding claim 1, GOHFER discloses a device comprising means for storing instructions, said instructions adapted to be executed by a processor of a computer, said instructions when executed by the processor executing a process comprising the steps of:

(a) obtaining a first data set, the first data set comprising at least one of the following: time history of fluid volumes (fluid volume, appendix I, page 3), time history of proppant volumes (proppant conc and fluid volume, appendix I, page 3), fluid properties (fluid properties, appendix I, page 3), proppant properties (proppant properties, appendix I, page 3), and geological properties of a layered reservoir, including layer interface locations (formation properties, appendix I, page 2),

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions (processor, section 1.1, page 4) the computer further having electronic storage means (RAM and hard disk, section 1.1, page 4) with stored equations comprising hydraulic fracturing relationships (model, section 4.2.2, page 28),

(c) computing by said processor a first set of values by manipulating said first data set using said stored equations (Executing, Chapter 4, pages 28-30), whereby the relations between stress and strain in the layered reservoir are determined (stress and strain, section 3.5.7.1-3.5.7.8),

(d) determining from said first set of values dimensions of a hydraulic fracture, the dimensions including fracture height and length, fracture width (Fracture Size vs. Time,

appendix I, page 7) and fluid pressures (Pressure vs. Time, appendix I, page 5) as a function of time, said hydraulic fracture intersecting at least one layer interface,

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs. Time, appendix I, page 5) as a function of pumping time,

(f) displaying the output data on a computer monitor (WinParse can be used as a run-time monitor, section 5, pages 31-43).

GOHFER fails to expressly disclose that in step (c) said manipulation including solving equilibrium equations for each layer by the use of a Fourier Transform method.

Linkov et al. propose an efficient method to solve problems for elastic multi-layered media with cracks, which arise in rock mechanics, using the Green function by means of Fourier transform and sweep-method. Having the Green function, one reduces the problem for damaged layers to solution of integral equation which is defined only on surfaces of cracks and can be solved by conventional boundary element method (abstract, page 338). Specifically, Linkov et al. disclose:

(c) said manipulation including solving equilibrium equations for each layer by the use of a Fourier Transform method (Fourier Transform can be effectively employed to solve the typical problems, page 346).

Linkov et al. disclose that problems for elastic multi-layered media with cracks arise in rock mechanics (abstract, page 338). In order to do the hydraulic fracturing analysis and design one of ordinary skill in the art would be motivated to solve these problems of elastic multi-

layered media, in addition to single-layered media, with cracks because they do arise in rock mechanics.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of GOHFER to incorporate the teachings of Linkov et al. to obtain the invention as specified in claim 1 because by using Fourier transform, Linkov et al. disclose an efficient method to reduce the multi-layered problem and solve it by conventional boundary element method.

**9-2.** Regarding claim 2, GOHFER further discloses that the step of determining from said first set of values dimensions of a hydraulic fracture is achieved using a mesh of elements (GOHFER is a grid based model, section 3.4, pages 13-15).

**9-3.** Regarding claim 13, GOHFER discloses a method comprising:

(a) obtaining a first data set (properties, etc., appendix I, pages 2-3),

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having electronic storage means (RAM and hard disk, section 1.1, page 4) with stored equations comprising hydraulic fracturing relationships (model, section 4.2.2, page 28),

(c) computing by said processor a first set of values by manipulating said first data set using said stored equations (Executing, Chapter 4, pages 28-30),

(d) determining the dimensions of a hydraulic fracture intersecting several layers using a mesh of elements (GOHFER is a grid based model, section 3.4, pages 13-15),

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs. Time, appendix I, page 5) as a function of pumping time.

However, GOHFER fails to disclose expressly that (1) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations, (2) the solution employing at least one inversion process, and (3) the equations including a Green's function.

Linkov et al. propose an efficient method to solve problems for elastic multi-layered media with cracks, which arise in rock mechanics, using the Green function by means of Fourier transform and sweep-method. Having the Green function, one reduces the problem for damaged layers to solution of integral equation which is defined only on surfaces of cracks and can be solved by conventional boundary element method (abstract, page 338). Specifically, Linkov et al. disclose:

(b) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations (Fourier Transform can be effectively employed to solve the typical problems, page 346), the solution employing at least one inversion process (Inverse transforms, page 346);

(c) the equations including a Green's function (use of the Green function, abstract, page 338).

Linkov et al. disclose that problems for elastic multi-layered media with cracks arise in rock mechanics (abstract, page 338). In order to do the hydraulic fracturing analysis and design one of ordinary skill in the art would be motivated to solve these problems of elastic multi-

layered media, in addition to single-layered media, with cracks because they do arise in rock mechanics.

Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of GOHFER to incorporate the teachings of Linkov et al. to obtain the invention as specified in claim 13 because by using Green function and Fourier transform, Linkov et al. disclose an efficient method to reduce the multi-layered problem and solve it by conventional boundary element method.

**9-4.** Regarding claim 14, GOHFER further discloses:

(f) displaying the data for a user (The View Graph function allows WinParse to become a run-time monitor, section 5.7, page 43).

**9-5.** Regarding claim 15, GOHFER further discloses:

(f) sending the data to a remote site by way of a transmission medium (a networking environment, section 1.1.3, page 4).

**9-6.** Regarding claim 16, GOHFER further discloses:

(f) printing the output data (The Report button generates a report that can be viewed on the screen and sent to the printer, section 5.4.5, page 39).

**9-7.** Regarding claim 17, it is a device claim including equivalent method limitation as recited in claim 13, and is rejected based on the same reasoning of claim 13.

**9-8.** Regarding claim 18, GOHFER further discloses that said pre-recorded means is selected from the group of magnetic tape, a magnetic disk, an optical disk, a CD-ROM (hard disk, section 1.1, page 4).

**9-9.** Regarding claim 19, GOHFER discloses a report generated by illustrating a characteristic or set of values for a fracturing operation of a formation penetrated by a wellbore, said formation having a reservoir of oil or gas, comprising the steps of:

(a) obtaining a first data set (properties, etc., appendix I, pages 2-3),

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having pre-recorded means (hard disk, section 1.1, page 4) with stored equations comprising hydraulic fracturing relationships (model, section 4.2.2, page 28),

(c) computing by said processor a first set of values by manipulating said first data set using said stored equations (Executing, Chapter 4, pages 28-30),

(d) determining the dimensions of a hydraulic fracture intersecting several layers using a mesh of elements (GOHFER is a grid based model, section 3.4, pages 13-15),

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs. Time, appendix I, page 5) as a function of pumping time, and

(f) generating a report (The Report button generates a report, section 5.4.5, page 39).

However, GOHFER fails to disclose expressly that (1) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations, (2) the solution employing at least one inversion process, (3) the equations including a Green's function.

Linkov et al. propose an efficient method to solve problems for elastic multi-layered media with cracks, which arise in rock mechanics, using the Green function by means of Fourier

transform and sweep-method. Having the Green function, one reduces the problem for damaged layers to solution of integral equation which is defined only on surfaces of cracks and can be solved by conventional boundary element method (abstract, page 338). Specifically, Linkov et al. disclose:

(b) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations (Fourier Transform can be effectively employed to solve the typical problems, page 346), the solution employing at least one inversion process (Inverse transforms, page 346);

(c) the equations including a Green's function (use of the Green function, abstract, page 338).

Linkov et al. disclose that problems for elastic multi-layered media with cracks arise in rock mechanics (abstract, page 338). In order to do the hydraulic fracturing analysis and design one of ordinary skill in the art would be motivated to solve these problems of elastic multi-layered media, in addition to single-layered media, with cracks because they do arise in rock mechanics.

Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of GOHFER to incorporate the teachings of Linkov et al. to obtain the invention as specified in claim 19 because by using Green function and Fourier transform, Linkov et al. disclose an efficient method to reduce the multi-layered problem and solve it by conventional boundary element method.

***Allowable Subject Matter***

**10.** Claims 6-10 and 12 are deemed novel and non-obvious over the prior art of record, and would be allowed once the above rejections under 35 U.S.C. 112, first paragraph, are overcome.

Dependent claims 3 and 4 would be allowable if rewritten to overcome the rejections under 35 U.S.C. 112, first and second paragraphs, set forth in this Office action and rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Applicant's Arguments***

**11.** Applicants argue the following:

(1) For claim rejections - 35 USC 112, first paragraph, "In Equation (1) and (2) the index notation was used", "In Equation (1), the choice of index is irrelevant" (pages 13-14, paper # 8).

(2) For claim rejections - 35 USC 112, second paragraph, claim 3 has been amended and claim 11 has been deleted (page 14, paper # 8).

(3) "claim 1 as revised is not anticipated by GOHFER that does not use a Fourier Transform method" (page 15, paragraph 1, paper # 8).

(4) As explained by Eduard Siebrits in the sworn declaration, "the author of the GOHFER model has always stated that his model was applicable to multi-layered formations" and "the Linkov model was not applicable for the case of cavities or cracks intersecting the layers boundaries as it is the case with hydraulic fracturing" (page 15, paper # 8).

***Response to Arguments***

**12.** Applicants' arguments have been fully considered.

**12-1.** Response to Applicants' argument (1). In view of Applicants' unpersuasive argument, claims 1-4, 6-10, and 12-19 are rejected under 35 U.S.C. 112, first paragraph, as detailed in sections **5** to **5-5** above.

**12-2.** Response to Applicants' argument (2). The original claim rejections of claims 3 and 11 under 35 U.S.C. 112, second paragraph, in paper # 6 for indefiniteness have been withdrawn.

**12-3.** Response to Applicants' argument (3). Applicants' arguments are persuasive. Therefore, the rejections of claims 1 and 2 under 35 U.S.C. 102(b) in paper # 6 have been withdrawn. However, upon further consideration, a new ground(s) of rejection is made, as detailed in sections **9-1** and **9-2** above.

**12-4.** Response to Applicants' argument (4). Applicants' arguments are not persuasive. Applicants only allege their conclusions about GOHFER and Linkov model without providing evidence why they are not applicable. Besides, as described in page 4 of the specification, "Methods employing PL3D accurately take into account geologic layers" and Applicants admitted that, in contradiction to Applicants' arguments, "One such program, known commercially as GOHFER". Claims 1-2 and 13-19 are rejected under 35 U.S.C. 103(a), as detailed in sections **9** to **9-9** above.

***Conclusion***

**13.** Applicants' amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

**14.** Any inquiry concerning this communication or earlier communications from the examiner should be directed to Herng-der Day whose telephone number is (703) 305-5269. The examiner can normally be reached on 9:00 - 17:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin J Teska can be reached on (703) 305-9704. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-7239 for regular communications and (703) 746-7238 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

Herng-der Day
September 3, 2003

HUGH JONES Ph.D.
PRIMARY PATENT EXAMINER
TECHNOLOGY CENTER 2100